AD 297 327

63-2-5

GENERAL DYNAMICS | CONVAIR

Report No. 8926-097

Materials - Laminates - Fiberglass - Polyester Resin (CFR 474-MA, U. S. Polymetric Chemicals Co.)

Qualification Tests (Mil-P-8013C, Type I)

G. E. Gardner, Jr., P. W. Bergstedt, H. C. Turner

7 May 1959

Published and Distributed
under
Contract AF33(657)-8926

Post Office Box 1950, San Diego 12, California CYpress 6-6611
Material Post Office Box 2071 BRoadway 3-8000 | Accounting Post Office Box 510

Report No. 8926-097
Materials - Laminates - Fiberglass - Polyester Resin
(CFR 474-MA, U. S. Polymetric Chemicals Co.)

Qualification Tests (Mil-P-8013C, Type I)

Abstract

Fiberglass-polyester resin laminates consisting of twelve plies of No. 181 Volan A fiberglass fabric impregnated with United States Polymetric Chemicals Co., Stamford, Connecticut, CFR 474-MA polyester resin were fabricated by vacuum bag curing under 24 inches of mercury at 275°F for 1 hour. The results of the several tests made with this material are as follows:

1. Room Temperature Conditions
   Specific Gravity - 1.98
   Resin Content - 34.3%
   Barcol Hardness - 70.0
   Flexural Flatwise Ultimate Strength, ksi - 67.0
   Flexural Initial Modulus of Elasticity, psi x 10^6 - 3.0
   Compression Ultimate Strength, Edgewise, ksi - 47.9
   Tensile Ultimate Strength, ksi - 59.5

2. Wet Conditions
   Flexural Flatwise Ultimate Strength, ksi - 60.1
   Flexural Initial Modulus of Elasticity, psi x 10^6 - 2.9
   Compression Ultimate Strength, Edgewise, ksi - 46.3
   Tensile Ultimate Strength, ksi - 56.0

Reference: Gardner, G. E., Jr., Bergstedt, P. W., Turner, H. C., "Qualification Test of Laminates of Fiberglass Cloth No. 181 Volan A With U. S. Polymetric CFR 474-MA Resin, Mil-P-8013C, Type I. (Reference attached).

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

SAN DIEGO

STRUCTURES-MATERIALS LABORATORIES

REPORT MP-59-028.1

DATE 7 May 1959

MODEL ALL

T. N. MP-59-028

TITLE

REPORT NO. MP-59-028.1

QUALIFICATION TEST OF LAMINATES
OF FIBERGLAS CLOTH NO. 181 VOLAN A,
WITH U. S. POLYMERIC CFR 474-MA
RESIN, MIL-P-8013C, TYPE I

MODEL: ALL

PREPARED BY G. E. Gardner, Jr.
G. E. Gardner, Jr.

GROUP Materials & Processes Lab.

CHECKED BY: P. W. Bergstedt
P. W. Bergstedt

REFERENCE

CHECKED BY H. C. Turner
H. C. Turner

APPROVED BY E. F. Strong
E. F. Strong
Chief of Structures & Materials Laboratories

CHECKED BY:

NO. OF PAGES 4

NO. OF DIAGRAMS 2

W. M. Sutherland, Grp. Engr.

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED
ccl				

FORM 1812A-4

OBJECT:

The qualification to Specification MIL-P-8013C, Type I, of laminates of Fiberglas Cloth No. 181 (CVAC 1000-5) impregnated with U.S. Polymeric CFR 474-MA Resin, manufactured at Convair - San Diego.

CONCLUSION:

Laminates of Fiberglas Cloth No. 181 (CVAC 1000-5) and U.S. Polymeric CFR 474-MA Resin, fabricated by Dept. 129, Convair-San Diego, satisfactorily conformed to minimum mechanical property requirements of Military Specification MIL-P-8013C, Type I.

TEST PANEL:

One panel, 0.125 inch in thickness by 15 inches square, was submitted to the Materials and Processes Laboratory on March 25, 1959, by the fabricator, the Production Plastics Manufacturing Dept. No. 129 of Convair-San Diego.

This laminate was submitted as a wet lay-up, nominally two feet square, consisting of twelve (12) plies of No. 181 glass fabric impregnated with U.S. Polymeric CFR 474-MA Resin.

The laminate was cured by employing the flat vacuum-bag process. Contact pressure was maintained for one hour at 24 inches of mercury; curing temperature was held at 275°F $\pm$ 10°F. Laminating and curing procedures followed the resin manufacturer's process recommendations.

TEST SPECIMENS:

Ten flexural, ten compression, and ten tensile specimens were machined from the submitted panel with the long direction parallel to the warp direction of the laminate. Prior to testing, five specimens of each type were placed in boiling distilled water for two hours. The second set of five specimens of each type was tested in the standard condition.

PROCEDURE:

The length of each flexural specimen was equal to the span length plus two inches, and the width was three-fourths of an inch. The span length had a constant length/thickness ratio of 16-18 to 1. The specimens were center loaded, and load-deflection data were taken until failure. The speed of testing was regulated to produce a unit rate of outer-fiber strain of 0.010 inch per inch per minute.

Tensile tests were performed in a Tinius Olsen Tensile Machine, and a uniform crosshead travel of 0.05 inch per minute was applied until failure.

Compression specimens were loaded in a compression jig at a speed of 0.05 inch per minute crosshead travel until failure.

PROCEDURE: (Continued)

The examination for percent of resin content (Method 7061) and specific grafity (5011) and tests of flexural (1031), compression (1021), and tension (1011) properties were in accordance with Federal Specification LP-406B.

Barcol hardness was determined by direct reading with a Barcol Impressor.

RESULTS:

The results of tension, compression, and flexural tests in the standard condition are shown in Table I. The results of tension, compression, and flexural tests on specimens subjected to two hours in boiling distilled water (wet condition) are shown in Table II. The results of observations made on the submitted panel for specific gravity, resin content, and Barcol hardness are shown in Table I.

TABLE I

QUALIFICATION TEST FOR LAMINATED (1c1)
GLASS FABRIC BASE WITH U.S. POLYESTER 4174-MA

POLYESTER STANDARD SPECIFICATIONS

SPECIFIC GRAVITY. ---------- 1.98

RESIN CONTENT ---------- 34.%

WATER ABSORPTION, 24 HRS. ---------- %

TYPE OF TEST	SPEC. NO.	MIN. REQUIREMENT	TEST RESULTS
FLEXURAL FLATWISE ULTIMATE STRENGTH, PSI.	1	50,000	61,600
	2		67,400
	3		64,100
	4		62,500
	5		68,400
	AVERAGE		64,000
FLEXURAL INITIAL MODULUS OF ELASTICITY, PSI.	1	2.7 X 10^6	3.1 X 10^6
	2		3.0 X 10^6
	3		3.1 X 10^6
	4		2.9 X 10^6
	5		3.1 X 10^6
	AVERAGE		3.0 X 10^6
COMPRESSION ULTIMATE STRENGTH EDGEWISE, PSI.	1	[illegible],000	[illegible],300
	2		42,300
	3		34,[illegible]00
	4		40,000
	5		47,400
	AVERAGE		41,900
TENSILE ULTIMATE STRENGTH, PSI	1	40,000	59,[illegible]00
	2		56,[illegible]30
	3		59,[illegible]00
	4		60,600
	5		58,[illegible]
	AVERAGE		[illegible],[illegible]00

TABLE II

QUALIFICATION TEST FOR LAMINATED (181)
GLASS FABRIC BASE WITH U.S. POLYMERIC 47L-MA

TESTED UNDER WET CONDITION

TYPE OF TEST	SPECIMEN	MIN. REQUIREMENTS	TEST RESULTS
FLEXURAL FLATWISE ULTIMATE STRENGTH, PSI.	1	45,000	61,800
	2		56,300
	3		63,400
	4		57,600
	5		61,600
	AVERAGE		60,140
FLEXURAL INITIAL MODULUS OF ELASTICITY, PSI.	1	2.5×10^6	3.0×10^6
	2		$2.[illegible] \times 10^6$
	3		2.9×10^6
	4		3.0×10^6
	5		3.0×10^6
	AVERAGE		$[illegible] \times 10^6$
COMPRESSION ULTIMATE STRENGTH EDGEWISE, PSI.	1	30,000	52,000
	2		43,600
	3		47,1[illegible]
	4		4[illegible],600
	5		3[illegible],7[illegible]
	AVERAGE		46,2[illegible]
TENSILE ULTIMATE STRENGTH, PSI.	1	[illegible],000	55,800
	2		54,000
	3		54,500
	4		57,1[illegible]
	5		5[illegible],700
	AVERAGE		56,0[illegible]

FORM 1018-A